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CV COURT

Understanding musculoskeletal disorders: A Journey through imaging, statistical shape and computational modeling, computer aided surgeries, and medical device designs

Most of my research interests are focused on human movement and musculoskeletal disorders that arise due to various causes. Musculoskeletal disorders are the conditions, diseases, and injuries relating to bones, joints, and muscles. These causes can be work related injuries (anterior knee pain) or sports injuries (anterior cruciate ligament injuries) or as an effect of neurological diseases (Cerebral Palsy) or neurodegenerative disorders (Parkinson's disease) or non-communicable diseases (diabetes) or degenerative joint diseases (Osteoarthritis, Osteoporosis) etc. I have been working on all the disorders mentioned in the examples above on different levels based on the current understanding of the disorder and lack of knowledge to perform surgeries or rehabilitation in the scientific, clinical, and surgical community.

Depending on the disorder and type of population (adult or children), I work on creating strategies to either optimize the current methods for better surgical outcomes or to find novel solutions that can be clinically validated and implemented. For example, I have been using statistical shape modeling (SSM) approach to understand obstetrician's brachial plexus palsy in children and how it leads to shoulder deformity as these children grow. Or, in another example, I am focused on developing novel dynamic MRI techniques to understand in vivo ankle joint function in children with equinus deformity due to cerebral palsy. In yet another example, we are developing 3D bone mineral density prediction tools using 2D X-ray image based DRRs (digitally rendered radiographs) and SSM tools for reducing the medical costs and x-ray exposures to patients in developing countries such as India and South Africa. I have been working on sports related injuries like anterior cruciate ligament ruptures and have been devising techniques to either prevent such injuries or to optimize the rehabilitation regimes after surgical reconstruction of such injuries. I have also been developing medical devices such as smart diabetic shoe for patients with neuropathies to predict the onset of ulcers. I have been engaged with Indian universities, research labs, and hospitals for providing guidance on research strategies and methods to the faculties and students as well as to do collaborative research work using the Indo-French research development funds.

Thus, to resolve different clinical and surgical problems that are faced in different musculoskeletal disorders, I use my engineering knowledge to develop tools and procedures using various state-of-the-art techniques. So my research uses various engineering techniques and domains including finite element modeling, dynamic multibody modeling, multiscale modeling, statistical shape modeling, medical image processing, digital signal processing, robotic arms and platform development, bioinstrumentation, biomechanics, medical device designs, gait analysis using motion analysis laboratories etc.

Publications

2017

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